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RED TIDE OCCURRENCES RECORDED IN MEXICO FROM 1980 TO 1992 [1]

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RESUMEN

Con el propósito de reconocer las localidades y la regularidad con que ocurren las mareas rojas, las especies que las causan y la presencia o ausencia de toxinas en sus productos celulares, los estudios planctológicos hechos durante 1980-1992 en las costas del Pacífico, en el Golfo de México y en el Caribe, empleando análisis cualitativos y cuantitativos por la técnica de Utermöhl para microplancton de muestras de agua en invertoscopio, son integrados en este trabajo. Cuarenta mareas rojas fueron registradas y de éstas, 30 fueron observadas en los últimos cinco años (1987-1992). Trece fueron tóxicas, producidas por: *Pyrodinium bahamense* (2), *Gymnodinium catenatum* (3), *Protoperidinium trochoideum* (2), *Protoperidinium* sp. (1), *Gonyaulax triacantha* (1), *Gymnodinium splendens* (1), *Alexandrium* sp. y *Gonyaulax* spp. (1), *Gymnodinium breve* (1), y *Prorocentrum minimum* (1). Las otras 27 mareas rojas fueron inocuas producidas por: *Mesodinium rubrum* (15), *Noctiluca scintillans* (3), *Ceratium furca* (4), *Ceratium tripos* (1), *Ceratium* sp. y *Prorocentrum* sp. (1), *Noctiluca* sp. y *Ceratium* sp. (1), *Gymnodinium sanguineum* (1) y *Prorocentrum* spp. (1). Sus tamaños relativos variaron de 100 ha (tóxica) a 8000 km^2 (tóxica), con densidades de 17 000 000 y 1 090 000 céls/l, respectivamente.

Palabras clave: dinoflagelados, México 1980-1992.

ABSTRACT

With the purpose of recognizing the localities and the regularity of occurrence of the red tides, the species which cause it and the toxicity or not of its cellular products, planktological studies made during 1980-1992 on the Pacific coast, in

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the Gulf of Mexico and in the Caribbean, using qualitative and quantitative tests (Utermöhl techniques by invertscope for microplankton of water samples) were integrated. Forty red tides were recorded, of which 30 occurred in the last five years (1987-1992). Thirteen were toxic, produced by: *Pyrodinium bahamense* (2), *Gymnodinium catenatum* (3), *Protoperidinium trochoideum* (2), *Protoperidinium* sp (1), *Gonyaulax triacantha* (1), *Gymnodinium splendens* (1), *Alexandrium* sp. and *Gonyaulax* spp. (1), *Gymnodinium breve* (1), and *Prorocentrum minimum* (1). The other 27 red tides were innocuous, produced by: *Mesodinium rubrum* (15), *Noctiluca scintillans* (3), *Ceratium furca* (4), *Ceratium tripos* (1), *Ceratium* sp. and *Prorocentrum* sp (1), *Noctiluca* sp. and *Ceratium* sp. (1), *Gymnodinium sanguineum* (1) and *Prorocentrum* spp. (1). Their magnitude varied from 100 ha (toxic) to 8000 km^2 (toxic), with densities of 17 000 000 and 1 090 000 cells/l, respectively.

Key words: dinoflagellate blooms, Mexico 1980-1992.

INTRODUCTION

Red tide is the common term for a series of biological phenomena resulting from microplankton blooms, mainly dinoflagellates, cyanophytes, diatoms and some ciliates. Due to the high density and their cellular pigments, they give a reddish appearance to the surface water, mainly in the coastal zone.

Such plankton blooms of procariotic and eucaryotic organisms are harmful to the environment due to the accumulation of extracellular metabolic products (Graneli *et al.*, 1990). In many cases these blooms are toxicogenic, and tests have been carried out for dinoflagellates and recently also for nitzschioids diatoms. Other detrimental effects are due to the lack of dissolved oxygen, causing occlusion of the respiratory organs of pelagic organisms and ultimately death (Taylor & Seliger, 1979; Smayda & Shimizu, 1991). During red tide blooms the marine aerosols containing toxins associated with marine particles cause severe respiratory irritation to humans along the shore (Pierce *et al.*, 1990). Their ingestion by fish, mollusks or crustaceans results in the accumulation of toxins in the tissues; if these, in turn, are consumed by humans or other vertebrates, intoxication will result and, depending on the type of toxin and its quantity , this may also cause death.

Nevertheless, despite the regular occurrence of red tides and their importance in public health due to frequent cases of poisoning caused by shellfish consume (Mee *et al.*, 1986), these phenomena have not been given sufficient attention. Unfortunately it was necessary for people to die before the importance of the occurrences of red tide was realized, in studies in the Mazatlan Bay, Sinaloa (Cortés-Altamirano, 1987; Cortés-Altamirano & Núñez-Pastén, 1992), in the Salina Cruz Bay, Oaxaca (Sotomayor-Navarro, 1992; Cortés-Altamirano *et al.*, 1993) and in some coastal lagoons (Gómez-Aguirre, 1987). These studies have been made more widely known through the Sociedad Mexicana de Planctología, A.C.

The literature on red tides in Mexico is sparse and mainly refers to dinoflagellates. If we consider the main publications on this topic, namely Osorio-Tafall (1942), Balech (1967, 1988), Hernández-Becerril (1987, 1988, 1991), Gárate-Lizárraga (1991), Turrubiates-Morales (1994), Gómez-Aguirre & Gómez-Noguera (1994), Gómez-Aguirre (1996), and Licea *et al.* (1995), a lack of continuity and follow-up to the investigations may be noted, in spite of the risk that these phenomena represent for public health.

The afore mentioned situation is in strong contrast with what is happening at the international level. As an example we need only mention such specialized studies as those of: Taylor & Seliger (1979), Anderson *et al.* (1985), Cosper *et al.* (1989), Graneli *et al.* (1990), Murphy (1991), Smayda & Shimizu (1991).

The purpose of the present work is to integrate data on red tides from recent years (1980-1992) with the aim of presenting a panorama of the occurrence of these phenomena in the seas of Mexico, and it attempts to show the importance of this problem, its increasing occurrence in the last decade, and its potential risk to public health, fishery resources and aquaculture management.

MATERIAL AND METHOD

Colleagues of various institutions throughout the country were contacted and requested the following data on red tides observed: locality, date and duration, estimate size in km^2, species involved density (cells/ml, applying the Utermöhl technique), toxic or innocuous character and type of stain produced. These data were collated with the information of the accumulated records from reports and related conferences and symposia in Mexico (i.e. Congreso Nacional de Oceanografía, Reunión de la Sociedad Mexicana de Planctología, International Symposium on Marine Biology).

RESULTS AND CONCLUSIONS

Information on 40 red tides during the period 1980 to 1992 was obtained (Fig.1 and Table 1). Thirty incidents are found in the records from the last five years (1987-1992), possibly because more attention has been paid to important locations on the Pacific coast, the afore mentioned Mazatlan Bay, Salina Cruz Bay, and in estuaries and coastal lagoons.

In table 1, in chronological order, 21 different locations from both the Pacific and the Atlantic coast of Mexico are shown, and the following details of the red tides are given: locality, date and duration, estimated size in km^2, species which produce them, density of population (cells/ml), their toxic or innocuous character, the type of stain observed and author references. This data was collected in field studies, and is untested in laboratories.

The red tides were observed during several months of the year, with a greater frequency in autumn and winter. They varied from a short period (one or several weeks) to some months and, in one case two years in a coastal lagoon in the Gulf of Mexico. Sixteen species which cause red tide were found: 15 dinoflagellates and one ciliate. The following 13, of 40 incidents, were toxic: *Pyrodinium bahamense* (2), *Protoperidinium trochoideum* (2), *Gonyaulax triacantha* (1), *Alexandrium* sp. and *Gonyaulax* spp. (1), *Gymnodinium catenatum* (3), *Protoperidinium* sp. (1), *Gymnodinium splendens* (1), *Gymnodinium breve* (1), and *Prorocentrum minimum* (1).

The other 27 red tides were innocuous, and were produced by: *Mesodinium rubrum* (ciliate, 15), *Ceratium furca* (4), *Ceratium* sp. and *Prorocentrum* sp. (1), *Gymnodinium sanguineun* (1), *Noctiluca scintillans* (3), *Ceratium tripos* (1), *Noctiluca* sp. and *Ceratium* sp. (1), *Prorocentrum* spp. (1).

The cellular density of red tides varied from 157 cells/ml (*Noctiluca scintillans*) in Concepción Bay, to 17 000 cells/ml (*Prorocentrum minimum*) in a shrimp farm in Mazatlán, Sinaloa, and the estimate of relative size were of 100 ha in shrimp farms to 8000 km^2 in Oaxaca.

The type of stain defined as a continuous path was the more common (Table 1).

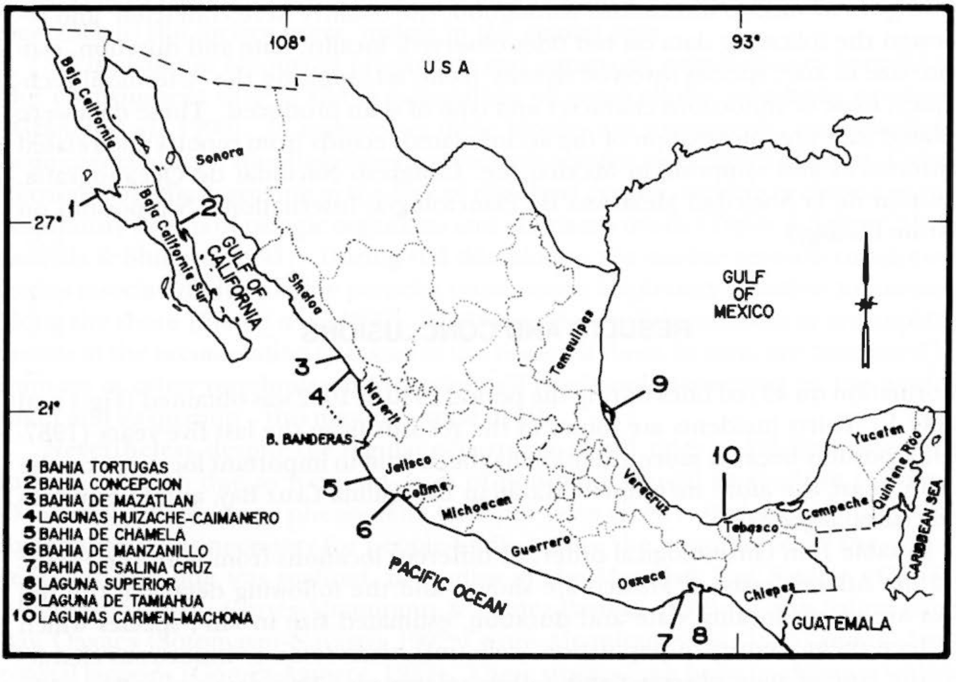


Fig. 1. Localities of red tides records in Mexico (1980-1992).

Table 1. Red tides in Mexico (1980-1992)

Locality	Date and duration	Estimated size (km²)	Species	Density population (cells/ml)	Toxic or Innocuous	Stains observed	Information sources
Bahía de Chamela, Jalisco	Apr. 80 3w	1000	*Gymnodinium splendens*	1300 to 3000	T	CP	GA
Laguna Superior, Oaxaca	Jan. 81 1w	100	*Ceratium* sp. and *Prorocentrum* sp.	700 to 900	I	CP	GA
Bahía de Banderas, Jalisco	May 81 2w	100	*Noctiluca* and *Ceratium* spp.	300 to 800	I	CP	GA
Laguna Carmen-Machona, Tabasco	Feb. 82 1w	100	*Ceratium furca* and *C.* spp.	1000	I	CP	GA
Golfo de California	Jun. 81 1w	1	*Mesodinium rubrum*	1081	I	CP	HB
Bahía de Chamela, Jalisco	Aug. 82 1w	100	*Prorocentrum* spp.	1000	I	CP	GA
Laguna de Tamiahua, Veracruz	Apr. 84 to Apr. 86	100	*Pyrodinium bahamense* var. *bahamense*	300 to 3000	T	CP	GA
Bahía Concepción, Baja California Sur	Feb. 86 1w	100	*Noctiluca scintillans*	157 to 182	I	CP	GL
Bahía de Manzanillo, Colima	Jun. 86 1w	100	*Ceratium furca*	315 to 5000	I	IP	GA
Texas to Tamaulipas	Oct. 86 3 w	1000	*Gymnodinium breve*	no estim.	T	CP	GA
Bahía de Mazatlán, Sinaloa	Feb. 87 1 w	no	*Gymnodinium catenatum*	no estim. estimated	T	CP	CA
	May. 87 -	"	*Mesodinium rubrum*	2000	I	IP	CA

w= weeks, m= months, T= Toxic, I= innocuous, IP= isolated path, CP= continued path, CA (Cortés-Altamirano), GA= (Gómez-Aguirre, GL (Gárate-Lizarraga), HB (Hernández -Becerril), SN (Sotomayor-Navarro), TM (Turrubiates-Morales).

Table 1. continued

Locality	Date and duration	Estimated size (km²)	Species	Density population (cells/ml)	Toxic or Innocuous	Stains observed	Information sources
Bahía de Mazatlán, Sinaloa	Dec. 87 -	not estimated	*Mesodinium rubrum*	2000	I	IP	CA
	Feb. 88 -	"	*Mesodinium rubrum*	2960	I	IP	CA
	Mar. 88	"	*Gymnodinium catenatum*	360	T	CP	CA
	Apr. 88 -	"	*Gymnodinium catenatum*	845 to 960	T	CP	CA
	Dec. 88 -	"	*Mesodinium rubrum*	7900	I	IP	CA
	Feb. 89 -	"	*Mesodinium rubrum*	2000	I	IP	CA
	Feb. 89 -	"	*Ceratium furca*	600	I	IP	CA
	Feb. 89	"	*Ceratium tripos* var. *ponticum*	100	I	CP	CA
	Mar. 89	"	*Mesodinium rubrum*	not estim.	I	IP	CA
	Apr. 89 -	"	*Protoperidinium* sp	not estim.	T	CP	CA
	May. 89 -	"	*Mesodinium rubrum*	not estim.	I	IP	CA
	Jul. 89 -	"	*Mesodinium rubrum*	not estim.	I	IP	CA
Lagunas Carmen-Machona, Tabasco	Sep. 89 1w	100	*Ceratium furca* and *C.* spp	800 to 1500	I	CP	GA
Bahías Salina Cruz-Huatulco, Oaxaca	Dec. 89 1w	8000	*Pyrodinium bahamense* var. *compressum*	1096	T	CP	SN
Bahía Concepción, Baja California Sur	Feb. 89 1w	100	*Noctiluca scintillans*	——	I	CP	GL
Bahía de Mazatlán, Sinaloa	Feb. 90 -	not estimated	*Mesodinium rubrum*	not estim.	I	IP	CA
	Mar. 90 -	"	*Mesodinium rubrum*	not estim.	I	IP	CA

Table 1, continued

Locality	Date and duration	Estimated size (km²)	Species	Density population (cells/ml)	Toxic or Innocuous	Stains observed	Information sources
Bahía de Mazatlán, Sinaloa	Apr. 90 -	not estimated	*Protoperidinium trochoideum*	808	T	CP	CA
	Aug-Sept.90	"	*Gonyaulax triacantha*	not estim.	T	CP	CA
	Aug-Sept. 90	"	*Protoperidinium trochoideum*	not estim.	T	IP	CA
Barra San Francisco, Oaxaca	Jul. 91 1w	80	*Mesodinium rubrum*	2395	I	IP	SN
Salina Cruz, Oaxaca	Apr. 91 -	5	*Noctiluca scintillans*	2207	I	IP	SN
La Chiche-B.S.Fco., Oax.-Tonalá, Chiapas	Apr. 91 1w	1	*Mesodinium rubrum*	5366	I	IP	SN
Bahía Zicatella-Pto. Escondido, Oaxaca	Apr. 91 1w	1	*Mesodinium rubrum*	1965	I	IP	SN
Bahía Tortugas, Baja California Sur	Apr-Aug.91 5 m	40	*Gymnodinium sanguineum*	860 to 90	I	CP	TM
Shrimp farms, Sinaloa	May-Jul. 91 ——	105 ha.	*Prorocentrum minimum*	17000 to 676	T	CP	CA
Barra San Francisco-Tonalá, Oax./Chiapas	Jul. 91. 1w	1	*Mesodinium rubrum*	1866	I	IP	SN
Lagunas Huizache-Caimanero, Sinaloa	Jan-Apr. 92	10 to 100	*Alexandrium* sp. and *Gonyaulax* spp.	1100 to 3500	T	CP	GA

Additional remarks. During the autumn and winter of 1992-1993 the occurrence of a new kind of red tide produced by *Pyrodinium bahamense* var. *compressum* and of a highly toxic nature became known. This was observed from the coast of Nicaragua, Guatemala and Chiapas, Mexico. The recurrence of this phenomena can be an indicator of the system of water masses from Central American converging towards the Gulf of Tehuantepec and other latitudes of Mexico, as was observed in October 1995, in the coast of Guerrero and Michoacan and then in December were reported in Guatemala, both incidents being produced by the same species. Finally, in October 1996, I recorded a high bloom of *Pyrodinium bahamense* var. *bahamense* in coastal lagoons of the Biosphere Reserve of Sian Ka'an (Gómez-Aguirre, 1998); and in 1997 (unpublished) the occurrence of red tide highly toxic, was observed in Baja California, Sinaloa and Tamaulipas. This major occurrence of toxic phytoplankton blooms, undoubtedly calls for the establishment of a more comprehensive system of monitoring these phenomena in Mexico and Central America. The prevention of human intoxications, the imposition of a closed season and sanitary or health measures, including medical and clinical treatments in case of intoxications becomes urgent.

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